

IN THE DRAWINGS

No objection to the drawings was indicted by the Examiner. As such, Applicants assume the drawings to be acceptable.

REMARKS

Pursuant to this amendment, claims 1, 10-12, 23, 26, and 28-30 have been amended and claims 2, 5-7, 25, 27, and 33 have been canceled without prejudice. No new matter is added. Accordingly, claims 10-15, 18 and 23-24, 26, 28-30, 32 and 34 are pending in the present application. In view of the arguments set forth below, Applicants respectfully request reconsideration of the application.

In the Final Office Action, the rejection of claims 1-3, 5-8, 10-15, 18, and 23-34 under 35 U.S.C. §102(b) as allegedly being anticipated by Japanese Patent document 2000-269178 Yamazaki, et al. (*Yamazaki*) was maintained. Applicants respectfully traverse the Examiner's §102 rejections.

Independent claim 1 sets forth, among other things, selectively applying a single etchant comprising a diluted mixture of hydrofluoric acid and nitric acid to an edge region of a substrate and removing unwanted material at least of a metal layer comprising copper and a barrier layer comprising tantalum selectively from the edge region wherein the single etchant is applied to remove material of said metal layer and said barrier layer. In other words, unwanted material of two different layers may be removed from an edge region of the substrate using a single etchant. By applying the method set forth in claim 1 enables removal of copper and tantalum based barrier material in a common etch process, a single etchant, for example, a diluted mixture of Hydrofluoric Acid (HF) and Nitric Acid (HNO₃). See Applicant's Specification on page 13, lines 23-25. For example, the etchant 121 may be comprised of a diluted mixture of and Nitric Acid (HNO₃). The ratio of de-ionized Water, Hydrofluoric Acid and Nitric Acid may be selected in accordance with the desired etch rate for a specified material, for instance, copper and tantalum being present in the seed layer 155 and the barrier layer 154, respectfully. See

Applicant's Specification on page 13, lines 6-10. Alternatively, the etchant 121 may be configured so as to remove the seed copper layer while a second etchant may remove the barrier layer 155 after the removal of the seed copper layer from the etch region 103. In this way, the copper, *i.e.*, the seed layer 155 and the barrier layer 154 may be selectively removed by one etchant instead of multiple etchants. See Applicant's Specification on page 14, lines 1-13.

However, *Yamazaki* does not teach or remotely suggest selectively applying a single etchant to an edge region of a substrate for selectively removing unwanted material of both layers of the metal and barrier material. Instead, *Yamazaki* sequentially applies two different etchant solutions to remove one layer at a time. For example, use of a FPM solution, defined as HF/H2O2/H2O in paragraph [0059] of *Yamazaki*, is disclosed for first etch removing the copper (Cu) around the circumference of surface of a wafer in paragraph [0088]. *Yamazaki* teaches again applying an etchant including HF, such as a HF solution for the removal of the barrier metal 38 in paragraph [0089] and drawing 22. In this manner, *Yamazaki* uses same etchant in two different solutions to sequentially remove two different layers from circumference of a wafer. It is respectfully submitted that *Yamazaki* fails to anticipate independent claim 1.

Yamazaki does not anticipate the invention set forth in claim 1 for many reasons. Claim 1 sets forth the act of removing unwanted material of a metal layer and a barrier layer selectively from the edge region by applying a single etchant to an edge region of a substrate. *Yamazaki* does not perform these acts. Instead, *Yamazaki* configures a nozzle to spout a treating liquid. That is, *Yamazaki* is generally directed to etching removal and cleaning method and apparatus in which a surface nozzle 14 may spout or eject the treating liquid either in a beam shape or in a spraying state. First, the FPM solution is ejected or sprayed from the etch nozzle 18 and the rear-face nozzle 16 to remove the seed Cu layer. Thereafter, HF solution is ejected or sprayed from

the etch nozzle 18 and the rear-face nozzle 16 to remove the barrier layer 38. See paragraph [0089] in *Yamazaki*.

In paragraph [0059], *Yamazaki*, provides examples of a solution to etch palating or seed copper (Cu) layer and in paragraph [0070] provides some examples of a penetrant remover. As understood, none of the examples including FPM and HF solutions, or Nitric Acid teach a common etchant, in a single etching solution that selectively removes both the Cu and barrier layers. In other words, *Yamazaki* teaches away from selectively applying a single etchant to selectively remove two layers of different materials together.

In *Yamazaki*, the FPM solution, identified by the Examiner as the first etchant and the HF solution, identified by the Examiner as the second etchant fail to remove the two layers of different materials together at a time. The present application indicates use of a common etch process with the etchant 121 comprising a diluted mixture of hydrofluoric acid (HF) and nitric acid (HNO_3) to remove both the copper and barrier layers in a one-step etch process. See Applicant's Specification on page 13, lines 6-7.

In contrast to the invention determined by claim 1, *Yamazaki* teaches applying two different etchant solutions with a common etchant sequentially to etch remove the copper (Cu) and barrier layers. A same etching reagent or a same penetrant remover is supplied from both the etch nozzle 18 and the rear-face nozzle 16, while a liquid, such as water may be supplied from the surface nozzle 14. The etching reagent or penetrant remover may be supplied from the etch nozzle in a shape of beam. However, the etching reagent or the permanent remover, such as the FPM solution is applied sequentially before the HF solution. See paragraph [0012] and [0017]. Since *Yamazaki* fails to teach or suggest providing selectively a single etchant that may

remove both the layers in a single etch step, claim 1 and claims dependent therefrom are not anticipated and are in condition for allowance which is respectfully requested of the Examiner.

The Examiner asserts that *Yamazaki* teaches all the features of claim 1. Applicants respectfully disagree. As discussed above, the Examiner makes a conclusory statement that "this is apparent from Figure 14 of *Yamazaki*, which shows the barrier layer (38) formed directly on silicon layer (32) and subsequently removed from the edge of the wafer, as claimed" based on this citation, the Examiner concludes that *Yamazaki* anticipates the present Application, as shown in Figure 14 of *Yamazaki*. Figure 14, in *Yamazaki*, shows a copper (Cu) layer 40 and a barrier layer (38) formed over an oxide film (SiO_2) 34. See Final Office Action, page 2.

However, in *Yamazaki*, in Figure 26, use of a single etching reagent or a penetrant remover in the FPM solution is shown. At most, use of a single etchant capable of removing a single layer, such as the copper (Cu) layer at a time is shown. Likewise, Figure 25 also depicts a similar setup. In other words, none of the drawings disclosed in *Yamazaki* along with the language described therein teach or suggest even remotely applying selectively a single etchant to remove two different layers, as set forth in claim 1. Thus, *Yamazaki* fails to teach or even suggest selectively applying a single etchant to an edge region of a substrate and removing unwanted material of the metal and barrier layers from the edge region.

For at least the aforementioned reasons, it is respectfully submitted that claim 1 and claims dependent therefrom are allowable over the art of record.

The Examiner does not cite to specific teaching that show the missing claimed features, instead, the Examiner advances a conclusory statement that *Yamazaki* teaches claim 1 features. Such a conclusory statement is clearly deficient because the office provides no citations in

Yamazaki to support the anticipation rejection. Applicants respectfully request that the pending claims are in condition for allowance. As thus understood, it is respectfully submitted that *Yamazaki* is completely silent as to selectively applying one or more etchants and removing unwanted material selectively of two different layers from and edge region of a substrate. At most, *Yamazaki* discloses use of two different etchant solutions sequentially to remove two different layers. In *Yamazaki*, a first etchant solution only removes a first layer, such as the copper layer, while a second etchant solution applied thereafter, removes the second layer, such as the barrier layer. However, *Yamazaki* does not teach or suggest selectively applying a single etchant that may remove both the layers. Additionally, other pending claims, to the extent they call for one or more of the above-noted missing features, are also allowable for these reasons. Reconsideration of present application is respectfully requested. Accordingly, a Notice of Allowance is respectfully solicited.

In view of the foregoing, Applicants respectfully submit that all pending claims are in condition for allowance. The Examiner is invited to contact the undersigned at (713) 934-4089 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

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